Amendments to the Drawings:

The drawing sheets attached in connection with the above-identified application containing Figures 4 and 5 are being presented as new formal drawing sheets to be substituted for the previously submitted drawing sheets. The drawing figures 4 and 5 have been amended.

The specific changes which have been made to Figures 4 and 5 is that the reference numeral 40 has been corrected to point to the correct element.

REMARKS

The Office Action mailed September 5, 2007, has been reviewed and the Examiner's comments carefully considered. Claim 5 has been amended. Therefore, claims 1, 3-5 and 7 remain pending in this application with claims 2 being withdrawn.

Drawings

The drawings were objected to for not including reference signs 20, 99 and 101. Further, the drawings were objected to because allegedly "element 40 references a different element in figs. 4 and 5 than in the rest of the drawings."

In response, reference signs 99 and 101 were removed from the specification. Further, reference sign 20 is shown in Fig. 1. Finally, figures 4 and 5 have been amended so that element 40 is consistent with the other figures. Accordingly, reconsideration and withdrawal of the objection is requested.

Specification

The specification was objected to for several informalities. In response, the specification has been amended to correct those formalities. Accordingly, reconsideration and withdrawal of the rejection is requested.

Amendments to the Abstract are presented as a new Abstract attached to this document or to replace the previously submitted Abstract. Reconsideration of the Abstract is respectfully requested.

Claim Objections

Claim 5 was objected to for informalities. In response, claim 5 has been amended to correct the informalities. Accordingly, reconsideration and withdrawal of the objection is respectfully requested.

Claim Rejections under 35 U.S.C. § 103

Claims 1, 3-5 and 7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,537,256 ("Fergason") in view of U.S. Patent No. 5,666,174

("Cupolo"). Applicant disagrees and respectfully traverses the rejection for the reasons that follow.

Response to Objections

Claim 1 recites:

> A display apparatus comprising:
>
> a spatial light modulator comprising an array of pixels each arranged to output substantially randomly polarized light;
>
> a birefringent lens positioned to receive light from the spatial light modulator arranged to direct light of a first polarization component into a first directional distribution and to direct light of a second polarization component into a second directional distribution different from the first directional distribution; and
>
> a linear polarizer.

In contrast, Fergason fails to disclose, teach or suggest a "birefringent lens" as claimed in claim 1. The examiner alleges that this element of claim 1 is met by the components 10 and 11 shown in Fig. 6 of Fergason. However, components 10 and 11 shown in Fig. 6 of Fergason are not in fact a "lens" as required by claim 1 because they are made of elements of uniform-thickness having planar faces and so cannot be or act as a lens.

Fergason refers to an apparatus to increase the resolution of an image from a spatial light modulator by dithering the position of pixel data from the display. Light from a spatial light modulator is polarized. A liquid crystal switching component 11 rotates the plane of polarization incident onto a slab of birefringent material 10 by 0 degrees and 90 degrees alternately. The slab of birefringent material 10 shifts the position of the incident light, depending on the polarization state that passes through. In particular as shown in Fig. 3, Fergason teaches that the birefringent material 10 with faces 32, 37 that provides a physical displacement of an image from an emissive display, the displacement depending on the polarization of light passing through the material. In this manner, the positional distribution of light from the display is modified. The optical components 10 and 11 are shown with flat surfaces with zero optical power (i.e. zero surface curvature). Fergason teaches the birefringent material 36 to have plane faces 32, 37. Column 7 line 33-34 describes that the

light enters at right angles to the face 32 and column 7 line 61 refers to the right hand face 37 of the crystal 30 (comprising the material 10). The use of the term 'face' defines a planar surface and indeed this is what is illustrated in Fig. 3, which illustrates the operation birefringent material 10. Thus, it is clear that Fergason teaches that the birefringent material has a pair of plane surfaces, intended to provide a physical displacement of the output light. Therefore, the material 10 cannot be a birefringent "lens" because it is not capable of focusing light.

Further, assuming *arguendo* Fergason has a birefringent lens, Fergason still fails to disclose, teach or suggest each and every element of claim 1.

The Examiner states that "Fergason discloses the claimed invention except for the spatial light modulator being an emissive spatial light modulator .... providing a quarter waveplate, wherein the quarter waveplate is arranged between the spatial light modulator and the birefringent lens and the linear polarizer is arranged on the opposite side of the birefringent lens from the quarter waveplate." However, the examiner alleges that these novel features are obvious from the disclosure of Fergason on column 8, lines 48-55. This point is respectfully traversed.

The disclosure on which the examiner relies on column 8, lines 48-55 of Fergason reads:

> "Quarter waveplates, other waveplates, etc. may be used in conjunction with coupling of light along optical paths used in the electronic dithering system I and/or the optical display systems 3 or 19, etc. Also, such waveplates may be used to convert plane polarized light to circularly polarize [sic] light or vice versa, depending on the nature of the optical coupling occurring in the various components and optical paths and/or the switch 11 used in the invention."

Applicant submits that this does not make it obvious for one skilled in the art to incorporate the combination of features required by claim 1, including (1) both a linear polarizer and quarter waveplate in combination, (2) the required locations of the linear polarizer and quarter waveplate, i.e. "the quarter waveplate is arranged between the spatial light modulator and the birefringent lens and the linear polarizer is arranged on the opposite

side of the birefringent lens from the quarter waveplate," and (3) the use of an spatial light modulator which is emissive.

Regarding point (1) it is noted that the purpose stated for the waveplate is "to convert plane polarized light to circularly polarize [sic] light or vice versa, depending on the nature of the optical coupling occurring in the various components and optical paths and/or the switch 11". Conversely the purpose of the linear polarizer 12 in Fergason is simply to polarize the light to prevent both polarization passing through the device which would prevent proper operation of the switch 11 and birefringent material 10. Although Fergason mentions the technical possibility of a quarter waveplate there is no motivation or incentive for this in combination with a linear polarizer.

Similarly, regarding point (3) there is no motivation or incentive from Fergason to combine the linear polarizer and quarter waveplate in the case of an emissive display. Although emissive displays are known, e.g. from Cupolo, this does not make it obvious to modify Fergason to use an emissive display in combination with applying a linear polarizer and quarter waveplate in combination. Further, no such reason or justification for modifying Fergason with Cupolo is stated in the Office action.

In contrast, the present application teaches on page 7, lines 1-10 the purpose of the combination of linear polarizer and quarter waveplate (cf point (1)) as being to act as a circular polarizer to reduce the reflections in the case of an emissive display (cf point (3)). This advantage is not taught by or obvious from Fergason or Cupolo.

Further, assuming *arguendo*, that feature (2) is obvious in view of Fergason, one skilled in the art, having a linear polarizer and quarter waveplate (point (1)) with an emissive display (point (3)), would still not have found it obvious to locate the linear polarizer and quarter waveplate as required by claim 1, i.e. "the quarter waveplate is arranged between the spatial light modulator and the birefringent lens and the linear polarizer is arranged on the opposite side of the birefringent lens from the quarter waveplate." Fergason does not provide any incentive or motivation to make this combination.

In contrast, the present application teaches on page 7, lines 11 to page 8, line 3 that the particular locations of the linear polarizer and quarter waveplate provide particular

advantages, in particular minimizing the distance between the spatial light modulator and the birefringent lens and also reducing losses. This advantage is not taught by or obvious from Fergason or Cupolo.

Further, modifying the claimed system with the features taught in Fergason would render the claimed apparatus unsatisfactory for its intended purpose. *See* M.P.E.P. § 2143.01. Specifically, in Fergason insertion of a quarter waveplate between the display 4 and the birefringent material 10 would cause significant image degradation as shown below.

The display of Fergason is required to periodically switch twice per frame period so as to provide a higher resolution image in synchronization with the output of a lower resolution display. *See* Col. 10, lines 5-16. In a 120Hz display, the time for a single frame is 8.3ms. In column 6 line 44, the switch cell 11 may be a liquid crystal cell or several liquid crystal cells. Practical switching cells known in the art suitable for such an application have a switching (driving or relaxing) response time from 1-20 milliseconds. Assuming the best case performance of 1ms, then for 12.5% of the time, the cell is not in the correct polarization state.

In Fergason's enhanced resolution mode operation of the device, this may not be a limitation, as the light from the display can be switched off (blanked) for this period. However, with the combination of features alleged to be obvious by the examiner, then significant degradation would result.

To achieve the suppression of unwanted reflection from the back electrode, the light that passes from the ambient through the front linear polarizer should be incident at 45 degrees to the quarter waveplate. The linear polarization state is converted to circular polarization, undergoes a reflection and is rotated to a linear polarization state which is extinguished by the polarizer, suppressing the reflection.

However, during the transition time of the polarization rotating switch 11, a 0 or 90 degree rotation of the incident polarization state is not achieved (for example a linear polarization state at a different angle or an elliptical polarization state is produced). For example, half way through the switching a linear output polarization state that is at 45 degrees to the polarizer transmission axis may be produced. This is aligned to the quarter waveplate

optical axis, and thus undergoes no phase change. This light is reflected from the display, and transmitted back through the quarter waveplate and polarizer. Thus, at this time, there is no reduction of reflectivity from the display surface. As described above, the switching transition (driving or relaxing) may be a significant proportion of the frame time. Further, the panel reflectivity may be very high to incident light. Thus, the display appears to act as a mirror to ambient light sources for a significant proportion of the frame time. This would be problematic for a user in normal lighting conditions.

Further, in order to achieve such short switching times in both directions of polarization rotation, Fergason teaches a 'push-pull' liquid crystal arrangement (by reference). Such an arrangement requires two liquid crystal cells which significantly increases the cost, weight and thickness of the device. In practical direct view display systems, a single polarization switcher would need to be used. This is more likely to have a longer response time in the relaxation direction, of a few milliseconds. Thus, the time over which the anti-reflection property does not work is extended as a proportion of the frame time, and the brightness of the reflection from the display will be increased.

To avoid such reflections, Fergason would only be motivated to position the quarter waveplate and polarizer between the panel and the elements 10, 11. Such an argument is also valid in the case of the addition of the non-birefringent lens 92 of Fergason.

It is noted this technical problem in Fergason is related specifically to the periodic switching required to operate the switch 10 and birefringent material 11. In contrast, the same problem is not present in the general case of the present invention, wherein the switching time is a single 'burst' of milliseconds duration, which is smaller than the integration time of the eye, and is not visible to an external observer.

Finally, Fergason would not operate to provide adequate reduction of reflection of the ambient light as provided by claims 1. In fact, one skilled in the art, reading Fergason, would be strongly motivated to position the elements after the quarter waveplate and polarizer combination to minimize reflections from the display.

Thus claim 1 should be allowed. In addition claims 3-5 and 7 depend from claim 1 and should be allowed for the reasons set forth above without regard to further patentable

limitations contained therein. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

Conclusion

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check or credit card payment form being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date February 5, 2008

By _____

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